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NATIONAL DAM SAFETY PROGRAM. P. D. KIRCHER DAM (MO 31074), OSAGE-ETC(U)
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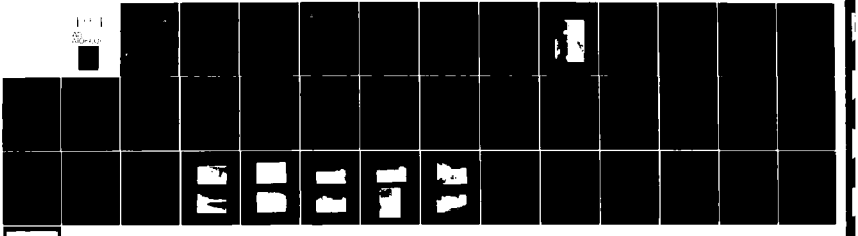

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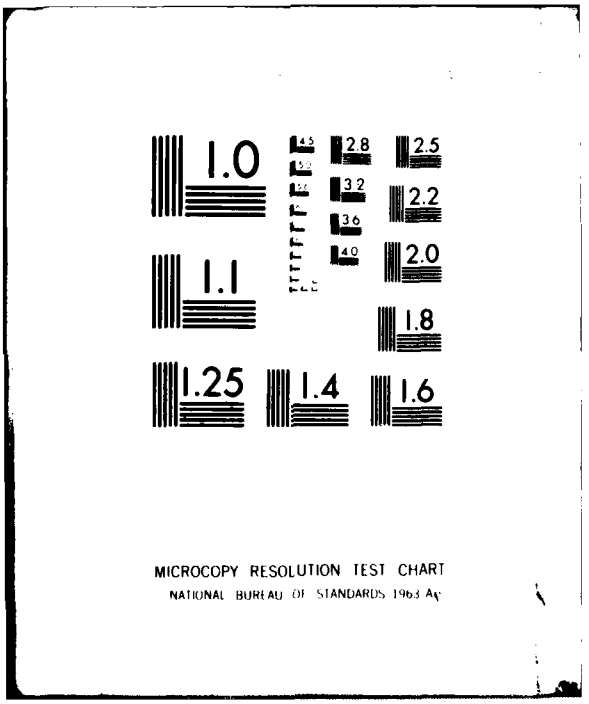
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LEVEL II

OSAGE-GASCONADE BASIN

P.D. KIRCHER DAM

CASS COUNTY, MISSOURI

MO 31074

PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY INSPECTION

United States Army Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

JUNE 1979

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REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A06601 / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Kircher P. D. Dam (MO 31074) Cass County, Missouri	5. TYPE OF REPORT & PERIOD COVERED Final Report / 6. PERFORMING ORG. REPORT NUMBER
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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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OSAGE-GASCONADE BASIN

P.D. KIRCHER DAM

CASS COUNTY, MISSOURI

MO 31074

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

JUNE 1979

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

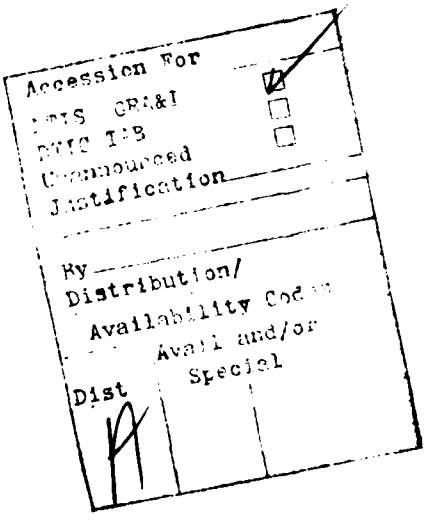
IN REPLY REFER TO

SUBJECT: P.D. Kircher Dam Mo. ID No. 31074
Phase I Inspection Report

This report presents the results of field inspection and evaluation of the P.D. Kircher Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY: SIGNED
Chief, Engineering Division
14 JAN 1980
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer
14 JAN 1980
Date



P. D. KIRCHER DAM

CASS COUNTY, MISSOURI

MISSOURI INVENTORY NO. 31074

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

UNDER DIRECTION OF

ST. LOUIS DISTRICT CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

JUNE 1979

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	P. D. Kircher Dam
State Located	Missouri
County Located	Cass County
Stream	Tributary to Camp Branch Creek
Date of Inspection	7 June 1979

P. D. Kircher Dam was inspected by a team of engineers from Black & Veatch, Consulting Engineers for the St. Louis District, Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and state agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. According to the St. Louis District, Corps of Engineers, failure would threaten the life and property of approximately six families downstream of the dam and would potentially cause appreciable damage to the bridges of two railroads and one bridge on an unimproved road within the estimated damage zone which extends approximately two miles downstream of the dam.

Our inspection and evaluation indicates the spillway does meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillway design flood recommended by the guidelines is 50 to 100 percent of the probable maximum flood. The spillway will not pass the probable maximum flood without overtopping but will pass 60 percent of the probable maximum flood, which is greater than the estimated 100-year flood. Considering the small volume of water impounded by the dam and the downstream hazard, 50 percent of the probable maximum flood is the appropriate spillway design flood. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Deficiencies visually observed by the inspection team were some minor erosion and growth of small trees on the front face, and some minor cracking. Seepage and stability analyses required by the guidelines were not available.

There were no observed deficiencies or conditions existing at the time of the inspection which indicated an immediate safety hazard. Future regular maintenance will be required to correct or control the described deficiencies. In addition, detailed seepage and stability analyses of the existing dam, are required by the guidelines. A detailed report discussing each of these deficiencies is attached.

Paul R. Laman

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Harry L. Callahan

Harry L. Callahan, Partner
Black & Veatch

OVERVIEW OF LAKE AND DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
P. D. KIRCHER DAM

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SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the District Engineer of the St. Louis District, Corps of Engineers, directed that a safety inspection of the P. D. Kircher Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth structure located in the valley of a tributary to Camp Branch Creek about a mile southwest of East Lynne, Missouri (Plate 1). The topography of the contributing area is characterized by low rolling hills. The watershed is primarily comprised of cropland. Topography in the vicinity of the dam is shown in Plate 2.

(2) The principal spillway is located in the left abutment. The principal spillway is a trapezoidal cut in the natural overburden and dam. Discharge through the principal spillway overflows through the valley downstream to the natural channel.

(3) An 8-inch steel water supply pipe with gate valve runs under the embankment to a wastewater lagoon. This pipe is located approximately 600 feet from the right abutment.

(4) A 1-1/2 inch water supply pipe is located 100 feet from the right abutment.

(5) Pertinent physical data are given in paragraph 1.3.

b. Location. The dam is located in east central Cass County, Missouri, as indicated on Plate 1. The lake formed by the dam is located in an area shown on the United States Geological Survey 7.5 minute series quadrangle map for East Lynne, Missouri in Section 33 of T45N, R30W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, the impoundment is in the small size category.

d. Hazard Classification. The hazard classification assigned by the Corps of Engineers for this dam is as follows: The P. D. Kircher Dam has a high hazard potential, meaning that the dam is located where failure may cause loss of life, and serious damage to homes, agricultural, industrial and commercial facilities, and to important public utilities, main highways, or railroads. For the P. D. Kircher Dam the estimated flood damage zone extends downstream for approximately two miles. Within the damage zone are six homes and two railroad bridges and one bridge on an unimproved road.

e. Ownership. The dam is owned by P. D. Kircher, R.R. 1, Box 600, Harrisonville, Missouri 64701.

f. Purpose of Dam. The dam forms a 26-acre water supply lake.

g. Design and Construction History. Data relating to the design and construction were not available. A description of the operating and maintenance of the dam was vervally provided by the owner.

h. Normal Operating Procedure. From fall until spring all inflow to the dam is impounded up to the elevation of the principal spillway. During the summer, water is utilized for irrigation as required by crops; normally the impoundment will be drained by fall. Water flows from the lake to a wastewater lagoon through the water supply pipe. Irrigation water is pumped from the lagoon to the fields. A dual purpose is served by this procedure. Wastewater is land applied and the crops are supplied irrigation water. Additionally the pond is also used as water supply for the dairy barn and as water supply for the herd.

1.3 PERTINENT DATA

a. Drainage Area - 326 acres.

b. Discharge at Damsite.

(1) Normal discharge at the damsite is through a controlled water supply pipe. The water level could be lowered below the normal pool elevation by use of the controlled outlet works.

(2) Estimated experienced maximum flood at damsite - Unknown.

(3) Estimated ungated spillway capacity at maximum pool elevation is 1,459 cfs (top of Dam El.871.1).

(4) Water is drained from the lake through a water supply pipe to a lagoon.

c. Elevation (Feet Above M.S.L.).

(1) Top of dam - 871.1 ± (see Plate 3)

(2) Spillway crest - 868.2

(3) Streambed at centerline of dam - 848.2 ±

(4) Maximum tailwater - Unknown.

d. Reservoir.

(1) Length of maximum pool - 1,500 feet ±

(2) Length of normal pool - 1,500 feet ±

e. Storage (Acre-feet).

(1) Top of dam - 300 (estimated)

(2) Spillway crest - 213 (estimated)

(3) Design surcharge - Not available.

f. Reservoir Surface (Acres).

(1) Top of dam - 33

(2) Spillway crest - 26

g. Dam.

(1) Type - Earth embankment

(2) Length - 1,300 feet ±

(3) Height - 23 feet ±

(4) Top width - 23 feet

(5) Side slopes - Upstream face 1.0 V on 2.2 H, downstream face 1.0 V on 3.4 H (see Plate 4).

(6) Zoning - Unknown.

(7) Impervious core - Unknown.

(8) Cutoff - Unknown.

(9) Grout curtain - Unknown.

h. Diversion and Regulating Tunnel - None.

i. Principal Spillway.

(1) Type - Grass open channel.

(2) Width of channel - 107 feet (see Plate 5).

(3) Crest elevation - 868.2 feet m.s.l.

(4) Gates - None.

(5) Upstream channel - Not applicable.

(6) Downstream channel - Grass valley with no defined channel.

j. Water Supply Outlet.

(1) Type - Pipe and gate valve.

(2) Size of pipe - 8-inch steel.

(3) Inlet elevation - Unknown.

(4) Outlet elevation - Unknown.

(5) Downstream channel - No channel, wastewater lagoon.

k. Water Supply Outlet.

(1) Type - Pipe and valve.

(2) Size of pipe - 1-1/2 inch.

(3) Inlet elevation - Unknown.

(4) Outlet elevation - Unknown.

(5) Downstream channel - Not applicable.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Design data were unavailable.

2.2 CONSTRUCTION

Construction records were unavailable, however, according to the owner the dam was built in 1974.

2.3 OPERATION

The maximum recorded loading on the dam is unknown.

2.4 GEOLOGY

The P.D. Kircher Dam is located across a very broad shallow valley which contains a small intermittent tributary of Camp Branch of Big Creek. The soils of the valley are classified as the Grundy, Dennis, and Roseland soil series. The Grundy series was developed by weathering of wind-deposited silt (loess) originating from glaciated rocks and soils. It is anticipated that either glacial till and/or residual soil underlie the Grundy series. Some alluvial soil may also be present. The Dennis and Roseland series are residual silty clay soils developed from weathering of shale and sandstone bedrock. The bedrock consists of sandstone and shale of the Marmaton Group of the Pennsylvanian Period.

2.5 EVALUATION

a. Availability. No engineering data could be obtained.

b. Adequacy. No engineering data were available upon which to make a detailed assessment of the design, construction, and operation. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. The validity of the design, construction, and operation could not be determined due to the lack of engineering data.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of P. D. Kircher Dam was made on 7 June 1979. The inspection team included professional engineers with experience in dam design and construction, hydrology - hydraulic engineering, and geotechnical engineering. The owner met the inspection team at the dam but did not accompany the team on the actual inspection. Specific observations are discussed below. No observations were made of the condition of the upstream face of the dam below the pool elevation at the time of the inspection. In general, the dam appeared to be in good condition.

b. Dam. The inspection team observed the following items at the dam. In general, the embankment appeared to be in good condition. Grass and small trees were growing on the upstream face of the dam. The left 150 feet of the upstream face of the dam was riprapped. Some minor erosion of the upstream face due to wave action was observed. The downstream slope of the dam was protected by a good grass cover. The crest of the dam was a gravel drive for farm vehicle traffic. No seepage was observed, however, the toe of the dam was unobservable because it was covered by a waste disposal lagoon. No animal burrows were observed in the embankment. Some shrinkage cracks were observed on the upstream edge of the crest. These cracks are considered to be minor with no detrimental affect on the dam stability. No evidence of sliding, settlement, or sinkholes was observed. No evidence exists that the dam has ever been overtopped.

c. Appurtenant Structures. The inspection team observed the following items pertaining to appurtenant structures. The principal spillway consists of a trapezoidal cut in the natural overburden and dam at the left abutment. The gravel drive which crosses the dam also crosses the principal spillway. There is a barbed wire fence on either side of the drive. Downstream of the principal spillway was a shallow, broad valley which drains through two railroad bridges. The water supply drain pipe consisted of 8-inch steel pipe with a gate valve. The pipe was not observable. The inlet was below the lake water surface; the outlet was below the downstream wastewater lagoon's water surface. Only the stem of the valve was observable. About 178 feet from the right abutment a gravel road projects into and crosses the lake. This is an earth filled structure with a 24-inch pipe so that both sides are hydraulically connected. The earth fill's primary affect on the impoundment would be to reduce storage. A 1-1/2 inch water supply pipe connects the dairy barn to the pond's water. This pipe was not observable.

d. Geology. A visual inspection of the soils and geology of the dam confirmed the presence of silty clay soils. The embankment material would be classified as CL material. The materials in the foundation and abutments of the dam are silty clay with no visible rock outcrops. They are anticipated to be alluvial, loessal and/or residual silty-clay soils overlying sandstone and shale bedrock at shallow depths.

e. Reservoir Area. No slides or excessive erosion due to wave action were observed along the shore of the reservoir.

f. Downstream Channel. The natural channel downstream from the primary spillway consists of an earth streambed. No outcropping is visible along the other bank. The stream banks are covered with brush and trees.

3.2 EVALUATION

The tree growth on the dam's upstream face should be controlled. The minor slope erosion in the area of the trees which is not riprapped should be monitored regularly. Other existing maintenance should be continued.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The pool is primarily controlled by rainfall, runoff, evaporation, and capacity of the uncontrolled principal spillway. During dry periods of heavy irrigation usage, water in the reservoir is pumped to irrigate crops until all water in storage is removed.

4.2 MAINTENANCE OF DAM

There is no regularly scheduled program for maintenance. Grass and brush on the embankment are cut periodically as needed.

4.3 MAINTENANCE OF OPERATING FACILITIES

The valve is operated as required during the irrigation season. Maintenance is performed as needed.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no existing system or preplanned scheme for warning occupants of the hazard zone below this dam.

4.5 EVALUATION

Several small trees on the upstream slope of the embankment have been allowed to grow. Some areas of minor erosion exist on the embankment. If these deficiencies are unchecked, they could lead to deterioration of the dam embankment.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Design data pertaining to hydrology and hydraulics were unavailable.

b. Experience Data. The drainage area and lake surface area are developed from the USGS East Lynne Quadrangle Map. The spillway and dam layouts are from surveys made during the inspection.

c. Visual Observations.

(1) The principal spillway is in good condition with no evidence of significant erosion or obstructions at the time of the inspection.

(2) The water supply outlets could be used for evacuating the pool.

(3) Spillway releases would not endanger the integrity of the dam.

d. Overtopping Potential. The spillway will not pass the probable maximum flood without overtopping the dam. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The spillway will pass 60 percent (1390 cfs) of the probable maximum flood without overtopping the dam. This flood is greater than the 100-year flood estimated to be 340 cfs developed by a 24-hour, 100-year rainfall. According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, a high hazard dam of small size should pass 50 to 100 percent of the probable maximum flood. Considering the small volume of water impounded by the dam and the downstream hazard, the appropriate spillway design flood should be 50 percent of the probable maximum flood. The portion of the estimated peak discharge of the probable maximum flood overtopping the dam would be 820 cfs of the total discharge from the reservoir of 3,510 cfs. The estimated duration of overtopping is 1.4 hours with a maximum height of 0.8 feet. The embankment should not be affected by overtopping for this short period of time.

According to the St. Louis District, Corps of Engineers, the effect from rupture of the dam could extend approximately two miles downstream of the dam. There are six homes, one bridge on an unimproved road, and the bridges of two railroads downstream of the dam which could be severely damaged and lives could be lost should failure of the dam occur.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which affect the structural stability of this dam are discussed in Section 3, paragraph 3.1b.

b. Design and Construction Data. No design data relating to the structural stability of the dam were found. Detailed seepage and stability analysis should be performed as required by the guidelines. It is anticipated that the stability of this dam will meet the suggested factors of safety included in the guidelines.

c. Operating Records. No operational records exist.

d. Post Construction Changes. There is no evidence which would indicate that post construction changes have been made.

e. Seismic Stability. The dam is located in Seismic Zone 1 which is a zone of minor seismic risk. A properly designed and constructed earth dam using sound engineering principles and conservatism should pose no serious stability problems during earthquakes in this zone.

Adequate descriptions of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the stability analysis required by the guidelines.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The growth of trees on the embankment and the areas of minor erosion on the dam's upstream face are deficiencies which should be remedied to prevent erosion and potentially hazardous problems. A seepage and stability analysis is needed to verify the safety of the embankment.

b. Adequacy of Information. Due to the lack of engineering design data, the conclusions in this report were based only on performance history and visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein. However, seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. It is the opinion of the inspection team that a program should be developed to implement remedial measures recommended in paragraph 7.2b as soon as possible.

d. Necessity for Phase II. The Phase I investigation does not raise any serious questions relating to the safety of the dam or identify any serious dangers that would require a Phase II investigation.

e. Seismic Stability. This dam is located in Seismic Zone 1. Adequate description of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the recommended stability analysis.

7.2 REMEDIAL MEASURES

a. Alternatives. No measures are recommended.

b. Operation and Maintenance Procedures. The following operation and maintenance procedures are recommended:

(1) Erosion protection should be maintained on the upstream slope of the dam to prevent erosion of embankment material due to wave action.

(2) Trees on the upstream face of the dam should be controlled.

(3) Check the downstream face of the dam periodically for seepage and stability problems. If seepage flows are observed or sloughing on the embankment slope is noted, the dam should immediately be inspected and the condition evaluated by an engineer experienced in design and construction of earthen dams.

(4) The current practice of owner inspection should be continued and deficiencies corrected as they arise.

(5) Seepage and stability analysis should be performed by a professional engineer experienced in the design and construction of dams.

(6) A detailed inspection of the dam should be made periodically by an engineer experienced in design and construction of dams. More frequent inspections may be required if additional deficiencies are observed or the severity of the reported deficiencies increases.

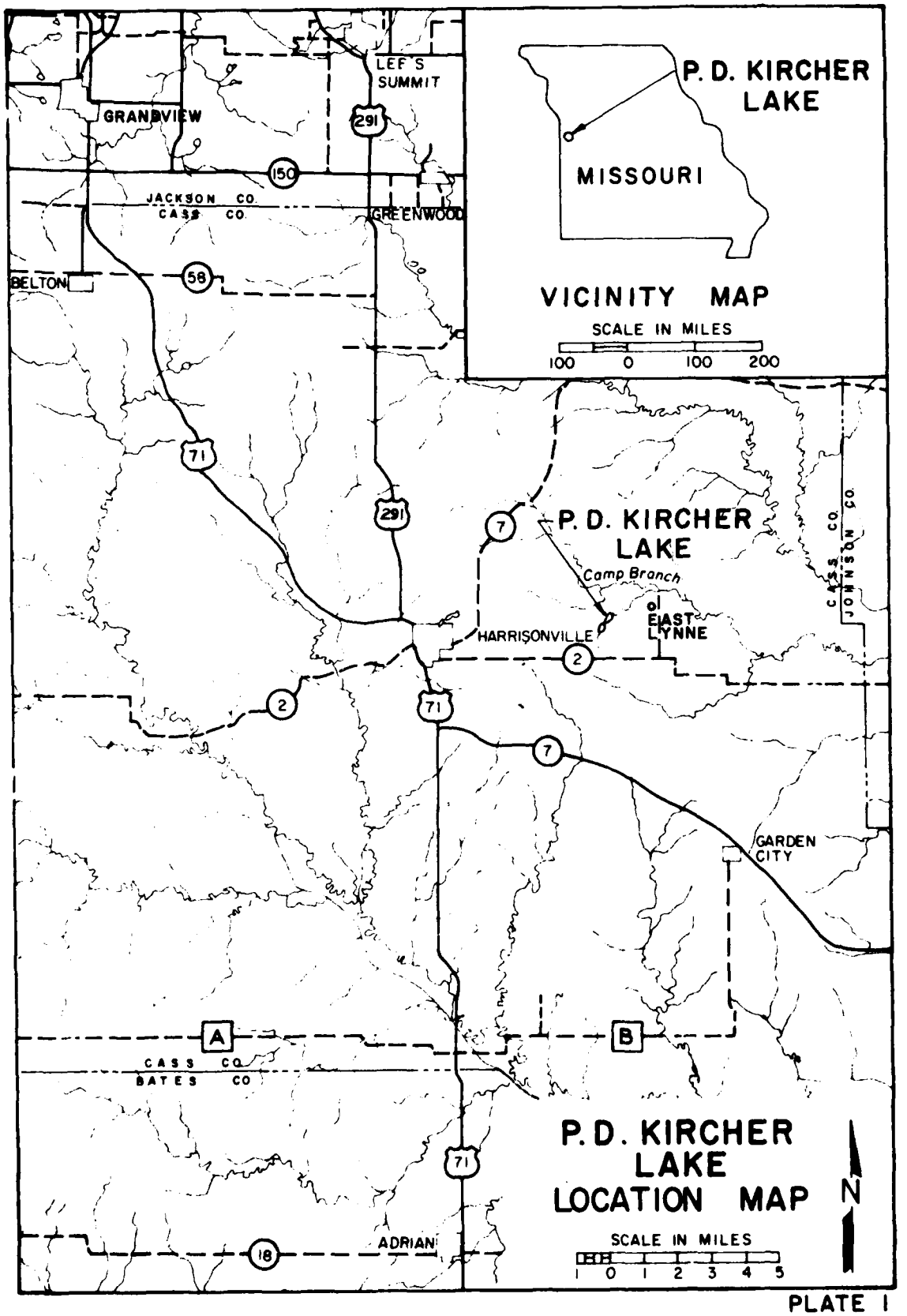

P. D. KIRCHER LAKE
MISSOURI
VICINITY MAP
SCALE IN MILES
100 0 100 200
LEE'S SUMMIT
GRANDVIEW
291
150
JACKSON CO.
CASS CO.
GREENWOOD
BELTON
58
71
291
7
P. D. KIRCHER LAKE
Camp Branch
EAST LYNNE
HARRISONVILLE
2
CASS CO.
JOHNSON CO.
2
71
7
GARDEN CITY
A
B
CASS CO.
BATES CO.
71
ADRIAN
18
P. D. KIRCHER LAKE LOCATION MAP
N
SCALE IN MILES
1 0 1 2 3 4 5

PLATE 1

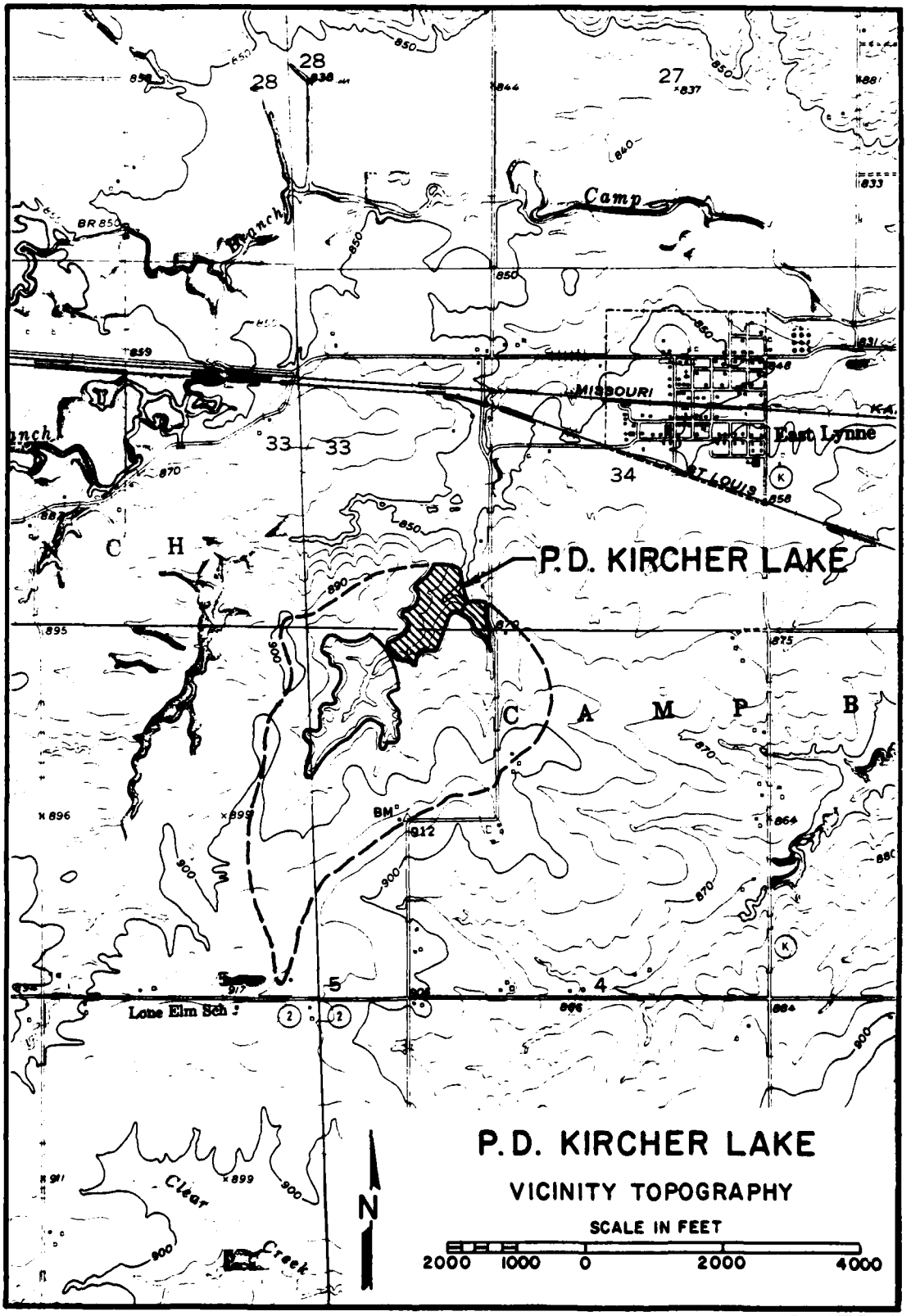

P.D. KIRCHER LAKE
C H
C A M P B
Camp
Branch
MISSOURI
East Lynne
St. Louis
Lone Elm Sch
Clear
Creek
N
P.D. KIRCHER LAKE
VICINITY TOPOGRAPHY
SCALE IN FEET
2000 1000 0 2000 4000

PLATE 2

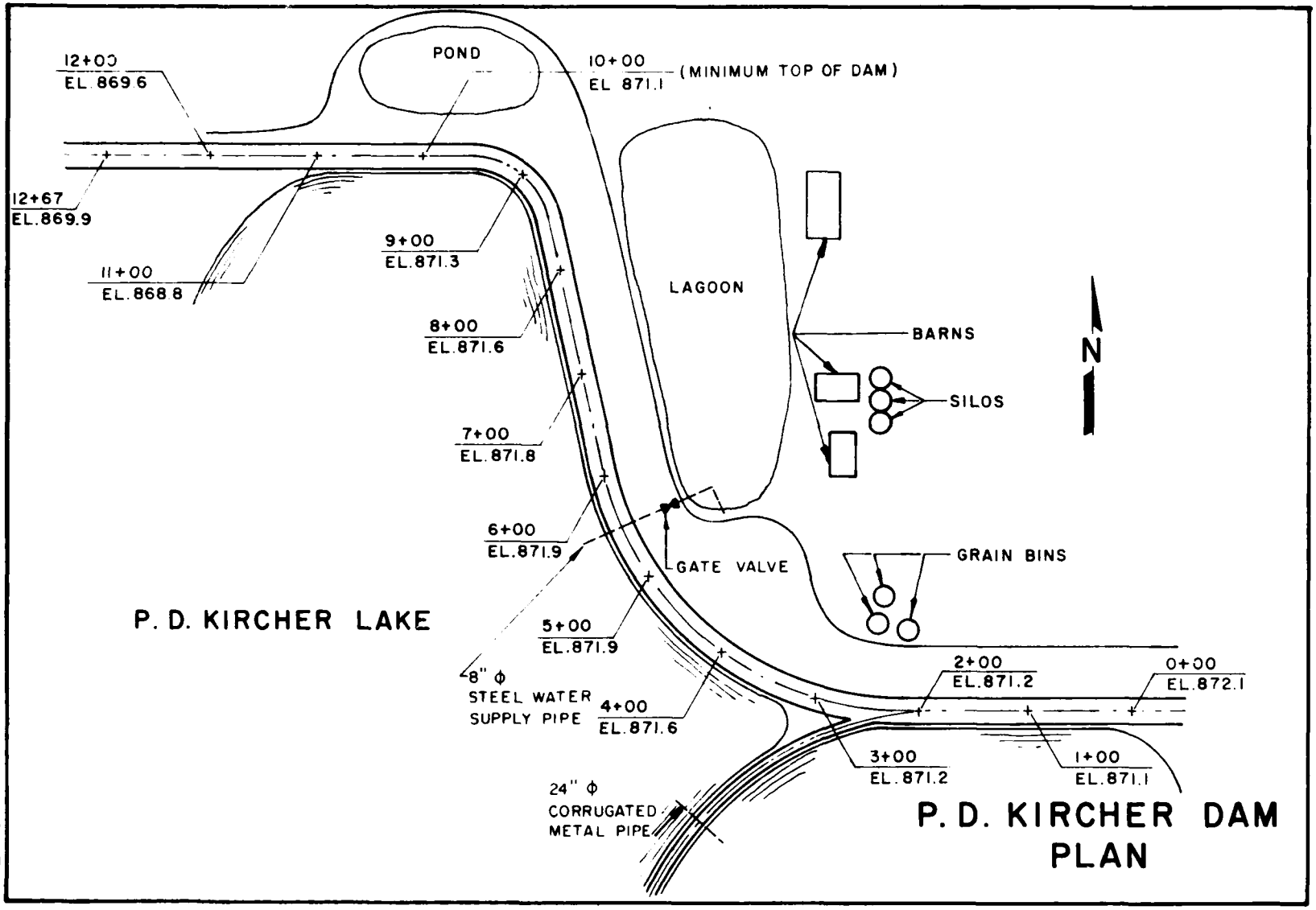

12+00
EL. 869.6
POND
10+00
EL 871.1
(MINIMUM TOP OF DAM)
12+67
EL.869.9
9+00
EL.871.3
11+00
EL.868.8
LAGOON
BARNS
8+00
EL.871.6
SILOS
N
7+00
EL.871.8
6+00
EL.871.9
GATE VALVE
GRAIN BINS
P. D. KIRCHER LAKE
5+00
EL.871.9
8" ϕ
STEEL WATER
SUPPLY PIPE
4+00
EL.871.6
2+00
EL.871.2
0+00
EL.872.1
3+00
EL.871.2
1+00
EL.871.1
24" ϕ
CORRUGATED
METAL PIPE
P. D. KIRCHER DAM
PLAN

PLATE 3

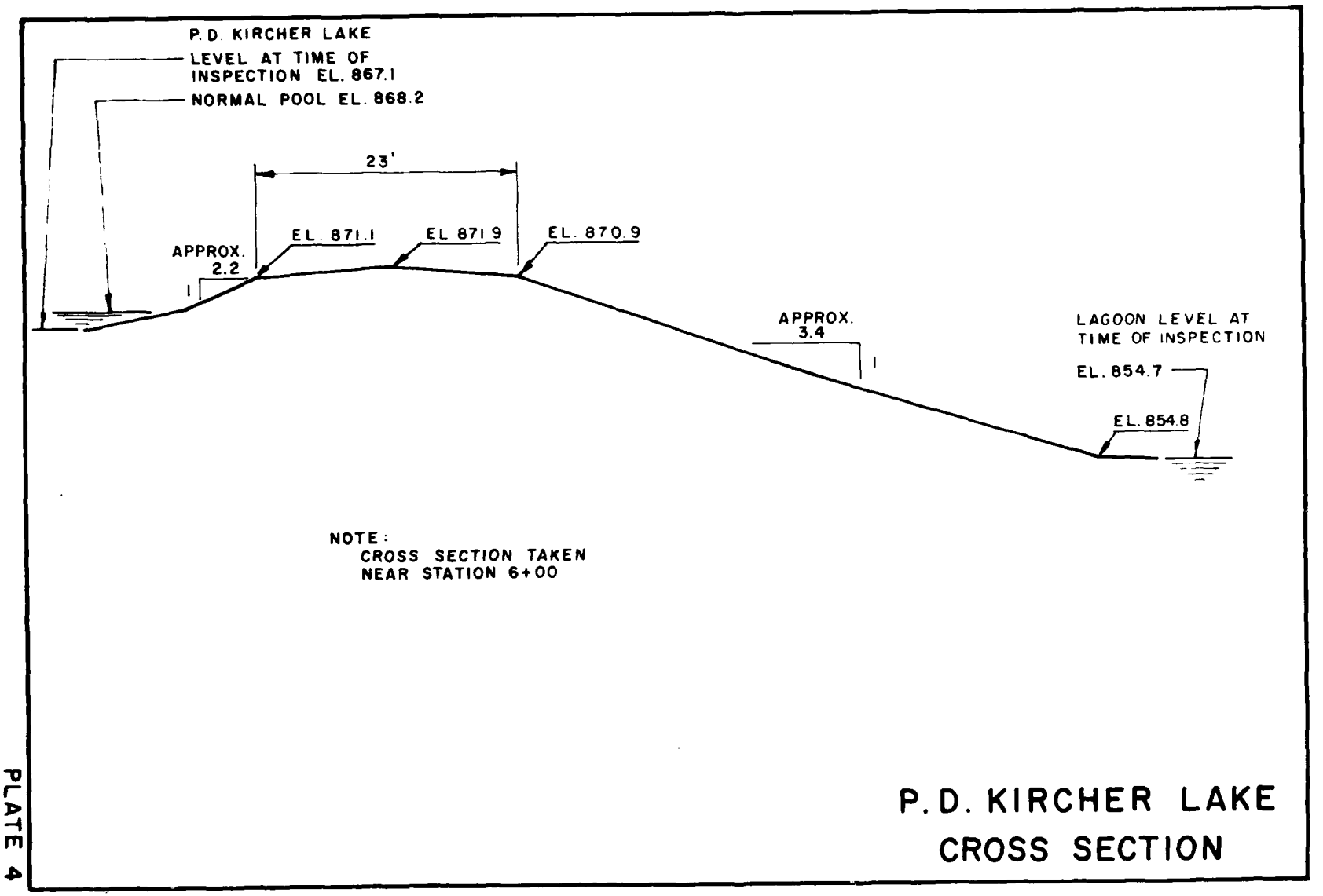
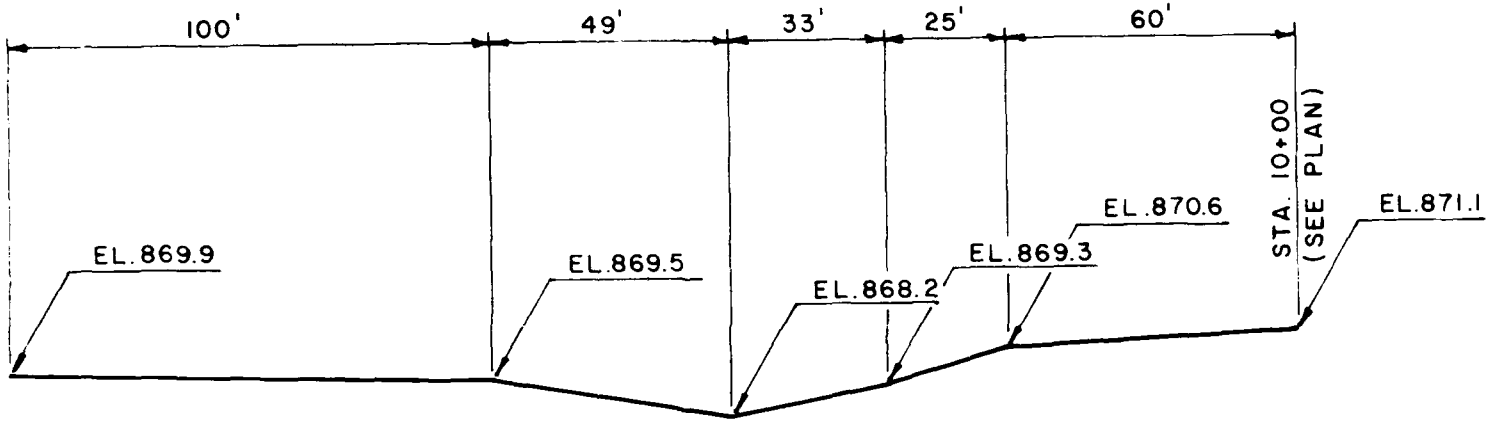

P.D. KIRCHER LAKE
LEVEL AT TIME OF INSPECTION EL. 867.1
NORMAL POOL EL. 868.2
23'
APPROX. 2.2
1
EL. 871.1
EL. 871.9
EL. 870.9
APPROX. 3.4
1
LAGOON LEVEL AT TIME OF INSPECTION
EL. 854.7
EL. 854.8
NOTE:
CROSS SECTION TAKEN NEAR STATION 6+00
P.D. KIRCHER LAKE
CROSS SECTION

PLATE 4



(LOOKING DOWNSTREAM)

P. D. KIRCHER DAM
SPILLWAY SECTION

PLATE 5

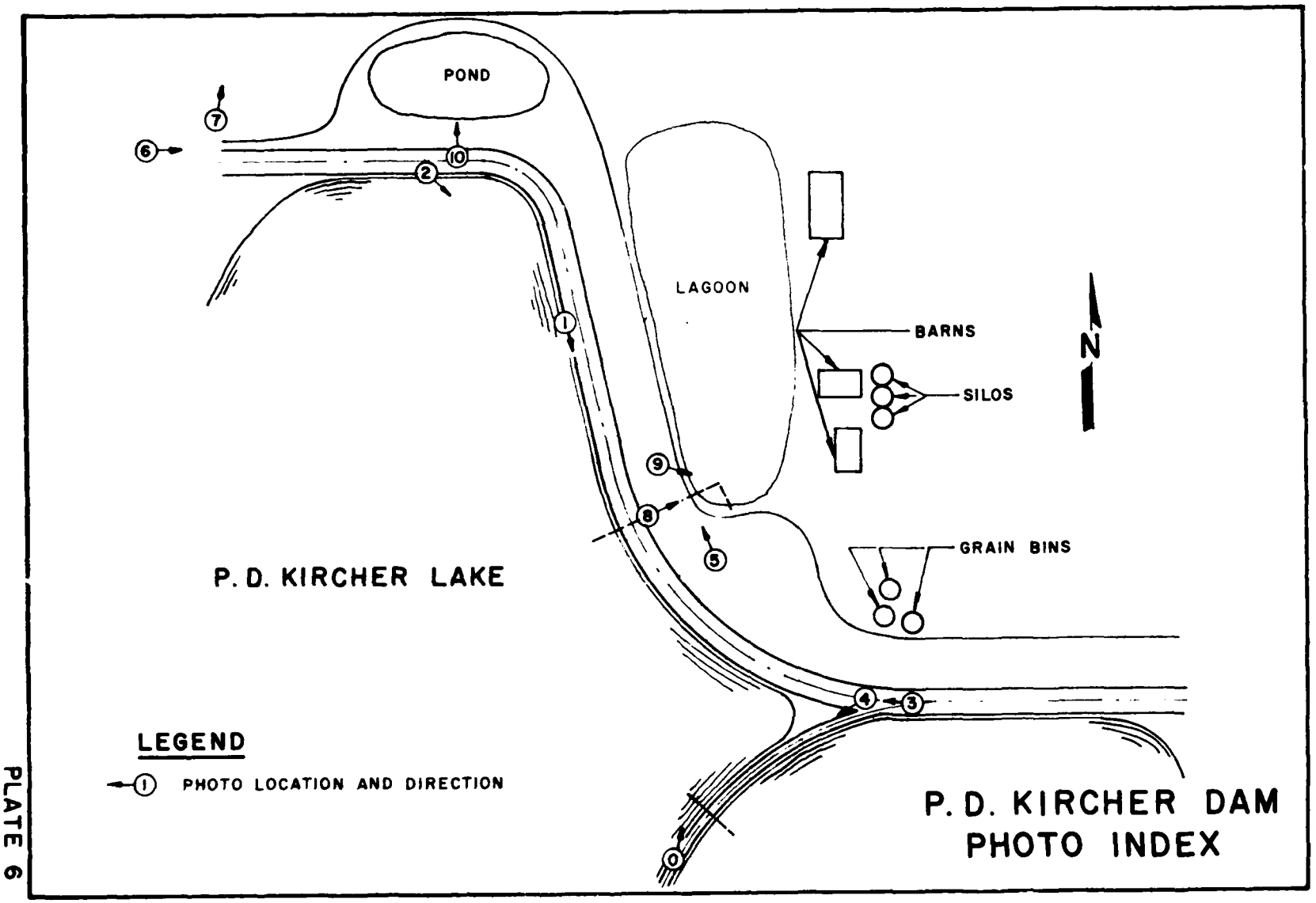

POND
LAGOON
BARNS
SILOS
GRAIN BINS
N
P. D. KIRCHER LAKE
LEGEND
① PHOTO LOCATION AND DIRECTION
P. D. KIRCHER DAM
PHOTO INDEX

PLATE 6

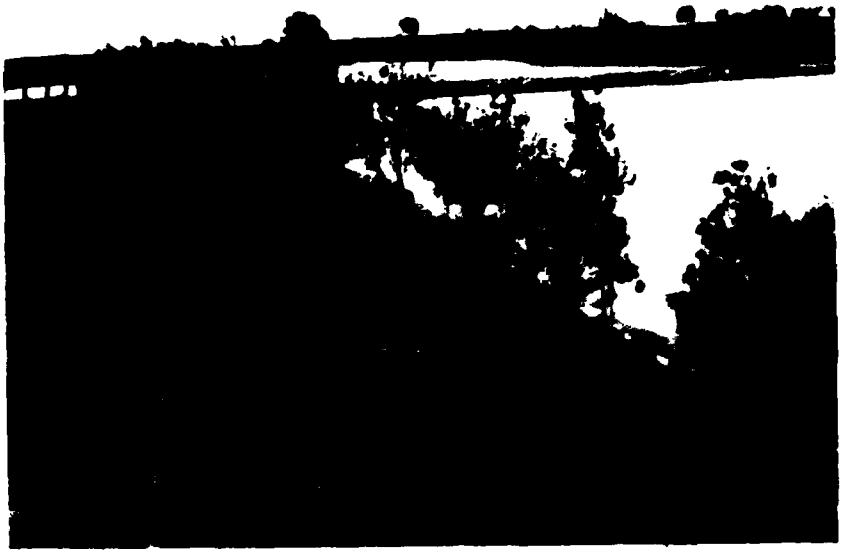


PHOTO 1: UPSTREAM FACE OF DAM LOOKING SOUTH

PHOTO 2: UPSTREAM FACE OF DAM LOOKING SOUTHEAST

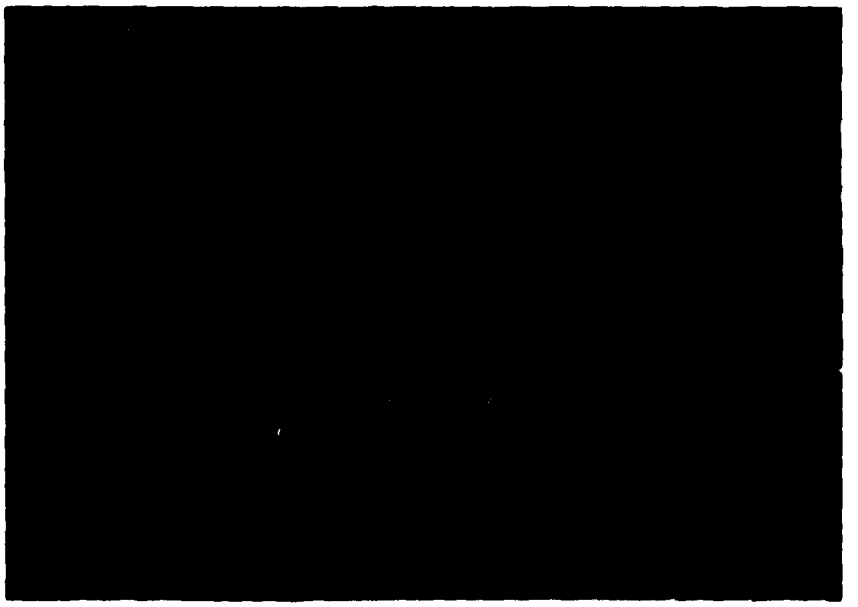


PHOTO 3: CREST OF DAM LOOKING EAST

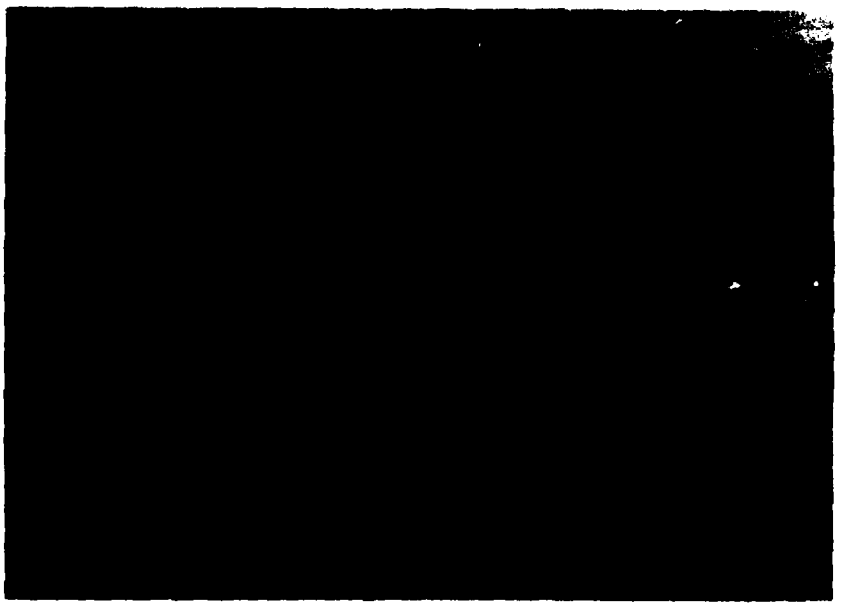


PHOTO 4: FARM ROAD ACROSS LAKE LOOKING SOUTH

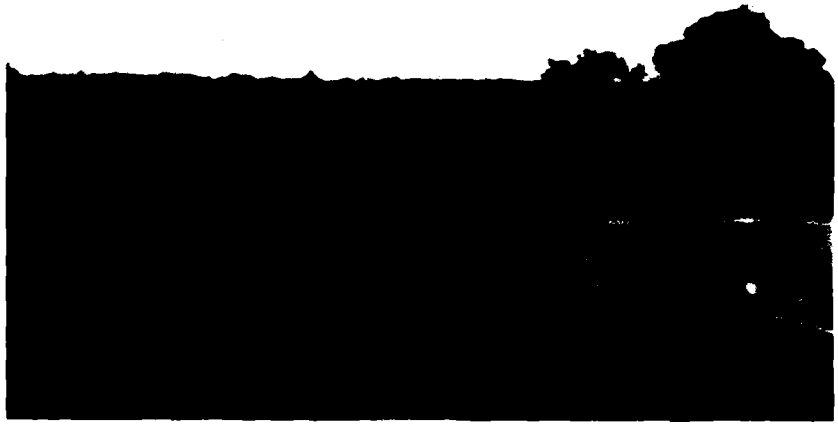


PHOTO 5: DOWNSTREAM FACE OF DAM AND LAGOON LOOKING NORTHWEST

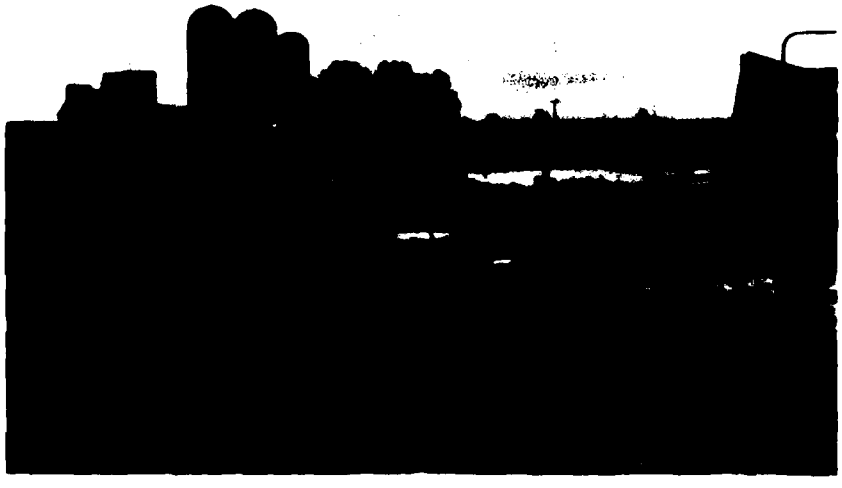


PHOTO 6: LOOKING ACROSS SPILLWAY

PHOTO 7: LOOKING DOWNSTREAM FROM SPILLWAY

PHOTO 8: GATE VALVE STEM ON DOWNSTREAM FACE OF DAM

PHOTO 9: WATER SUPPLY LINES AT DOWNSTREAM TOE OF DAM

PHOTO 10: POND LOOKING NORTH

APPENDIX A

HYDROLOGIC COMPUTATIONS

HYDROLOGIC COMPUTATIONS

1. The Soil Conservation Service (SCS) dimensionless unit hydrograph (1) and HEC-1 (2) were used to develop the inflow hydrographs and hydrologic inputs as follows:

a. Twenty-four hour, probable maximum precipitation determined from U.S. Weather Bureau Hydrometeorological Report No. 33.

200 square mile, 24 hour rainfall inches	- 24.7
10 square mile, 6 hour percent of 24 hour 200 square mile rainfall	- 101%
10 square mile, 12 hour percent of 24 hour 200 square mile rainfall	- 120%
10 square mile, 24 hour percent of 24 hour 200 square mile rainfall	- 130%

b. Drainage area = 326 acres.

c. Time of concentration: $T_c = (11.9 \times L^3/H)^{0.385} = 0.45$ hours = 27 minutes (L = length of longest watercourse in miles, H = elevation difference in feet) (3)

d. Losses were determined in accordance with SCS methods for determining runoff using a curve number of 94 and antecedent moisture condition III. The Soil Association in this watershed was Grundy (4). The hydrologic soil group in the basin was C.

e. The 100-year frequency inflow hydrograph was developed using a curve number of 85 and antecedent moisture condition II. Data for the 100-year, 24-hour rainfall, totaling 7.7 inches, was provided by the Corps of Engineers, St. Louis District.

2. Discharge rates for the spillway and over the top of the dam are based on the broad-crested weir equations for level weirs and for unlevel weirs:

Level weirs: $Q = CLH^{1.5}$ (C = 2.54 to 2.96,
L = Length of flow normal to the weir in feet, and
H is the head on the weir in feet)

Unlevel weirs: $Q = \frac{2Cb}{5(h_b - h_a)} (h_b^{2.5} - h_a^{2.5})$

(C = 2.54 to 3.05, b is the length of flow normal to the weir in feet, h_b is the head on the low end of the weir in feet, and h_a is the head on the high end of the weir in feet)

3. The elevation-storage relationship above normal pool elevation was constructed by planimetering the area enclosed within each contour above normal pool. The storage between two elevations was computed by multiplying the average of the areas at the two elevations by the elevation difference. The summation of these increments below a given elevation is the storage below that level.

4. Floods are routed through the spillway using HEC-1, modified Puls to determine the capability of the spillway.

(1) U.S. Department of Agriculture, Soil Conservation Service, National Engineering Handbook, Section 4, Hydrology, August 1972.

(2) U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package (HEC-1), Dam Safety Version, July 1978, Davis, California.

(3) U.S. Department of the Interior, Bureau of Reclamation, Design of Small Dams, 1974, Washington, D.C.

(4) Mid-America Regional Council, Regional Soils Guide, March 1976.

(5) Horace W. King and Ernest F. Brater, Handbook of Hydraulics, Sixth Edition, McGraw Hill Book Company, 1976.

(6) U.S. Department of the Interior, Geological Survey, Techniques of Water-Resources Investigations, Book 3, Chapter A5, Measurement of Peak Discharge at Dams by Indirect Method, by Harry Hulsing, 1967.

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FLOOD  . HOGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
     1              A1MISSOURI DAM INSPECTION PROGRAM
     2              A2ST LOUIS DISTRICT  US ARMY CORPS OF ENGINEERS
     3              A3 J.M.KIRCHER DAM I.D.#31075 & P.D.KIRCHER DAM I.D.#31074
     4              B    288       0       5       0       0       0       0       0       0       0
     5              B1     5
     6              J      1       9       1
     7              J1    .5      .55      .6      .65      .7      .75      .8      .9      1.
     8              K      0       1                                3       1
     9              K1   J.M.KIRCHER (24HR. PROBABLE MAXIMUM RUNOFF)
    10              M      1       2    .310                        1
    11              P             24.7     101     120     130
    12              T                                                      -1      -94
    13              W2            .25
    14              X                      1
    15              K      1       2                                       1
    16              K1   ROUTING THROUGH J.M.KIRCHER RESERVOIR
    17              Y                                      1       1
    18              Y1     1                                        -882.2      -1
    19              Y4882.2 882.5   883.0   883.5   884.0   884.2   884.5   885.0   885.5   886.0
    20              YS0.0   15.5    71.     148.    253.    313.    497.    1423.   3470.   6340.
    21              SS0.    0.4     25.6    175.9   609.4
    22              SE858.  860.    870.    880.    890.
    23              SS882.2
    24              SD884.2
    25              K      0       7                                3       1
    26              K1   OTHER AREA ABOVE P.D.KIRCHER DAM (24HR. PROBABLE MAXIMUM RUNOFF)
    27              M      1       2   0.20                         1
    28              P             24.7     101     120     130
    29              T                                                      -1      -94
    30              W2            .14
    31              X                      1
    32              K      2       4                                       1
     ?              K1   COMBINE HYDROGRAPHS - TOTAL INFLOW HYDROGRAPH TO P.D.KIRCHER  (24HR. PMF)
                    K      1       5                                       1
    35              K1   ROUTING THROUGH P.D.KIRCHER RESERVOIR
    36              Y                                      1       1
    37              Y1     1                                        -868.2      -1
    38              Y4868.2 868.5   869.0   869.5   870.0   870.5   871.0   871.1   871.5   872.0
    39              Y4873.0
    40              YS   0.03.      41.     143.    370.    773.    1326.   1459.   2222.   3953.
    41              Y510297.
    42              SS0.0   0.3     52.8    248.3   719.3
    43              SE849.  850.    860.    870.    880.
    44              SS868.2
    45              SD871.1
    46              K     99
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PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1
ROUTE HYDROGRAPH TO 2

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1 .50	RATIO 2 .55	RATIO 3 .60	RATIO 4 .65	RATIO 5 .70	RATIO 6 .75	RATIO 7 .80	RATIO 8 .90	RATIO 9 1.00
HYDROGRAPH AT	1	.31	1	1513.	1664.	1815.	1967.	2118.	2269.	2421.	2723.	3026.
	(	.80)	(	42.84)(	47.13)(	51.41)(	55.69)(	59.98)(	64.26)(	68.54)(	77.11)(	85.68)
ROUTED TO	2	.31	1	837.	1029.	1209.	1375.	1595.	1790.	1980.	2322.	2620.
	(	.80)	(	23.71)(	29.14)(	34.22)(	38.94)(	45.15)(	50.69)(	56.07)(	65.75)(	74.19)
HYDROGRAPH AT	3	.20	1	1265.	1392.	1518.	1645.	1771.	1898.	2024.	2277.	2530.
	(	.52)	(	35.82)(	39.40)(	42.99)(	46.57)(	50.15)(	53.73)(	57.31)(	64.48)(	71.64)
2 COMBINED	4	.51	1	1551.	1748.	1977.	2306.	2585.	2839.	3073.	3578.	4072.
	(	1.32)	(	43.91)(	49.27)(	55.98)(	65.30)(	73.19)(	80.39)(	87.02)(	101.33)(	115.30)
ROUTED TO	5	.51	1	1007.	1199.	1394.	1636.	1876.	2136.	2447.	3024.	3513.
	(	1.32)	(	28.51)(	33.96)(	39.48)(	46.32)(	53.12)(	60.48)(	69.28)(	85.63)(	99.49)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
		882.20	882.20	887.20

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	868.20	868.20	871.10
STORAGE	213.	213.	300.
OUTFLOW	0.	0.	1459.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	870.71	0.00	282.	1007.	0.00	16.25	0.00
.55	870.89	0.00	290.	1199.	0.00	16.25	0.00
.60	871.05	0.00	298.	1396.	0.00	16.25	0.00
.65	871.19	.09	304.	1636.	.50	16.17	0.00
.70	871.32	.22	310.	1876.	.75	16.08	0.00
.75	871.45	.35	317.	2136.	.92	16.08	0.00
.80	871.56	.46	322.	2447.	1.08	16.08	0.00
.90	871.73	.63	330.	3026.	1.25	16.00	0.00
1.00	871.87	.77	337.	3513.	1.42	16.00	0.00

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

END

DATE
FILMED
12-81

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